(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 697 190 A1

(12) EUROPEAN PATENT APPLICATION

published in accordance with Art. 158(3) EPC

(43) Date of publication:
21.02.1996 Bulletin 1996/08

(21) Application number: **95909959.9**

(22) Date of filing: **22.02.1995**

(51) Int. Cl.[6]: **A61B 3/13**, A61B 3/10

(86) International application number: **PCT/JP95/00258**

(87) International publication number: **WO 95/22926**
(31.08.1995 Gazette 1995/37)

(84) Designated Contracting States:
DE FR GB

(30) Priority: **28.02.1994 JP 29938/94**

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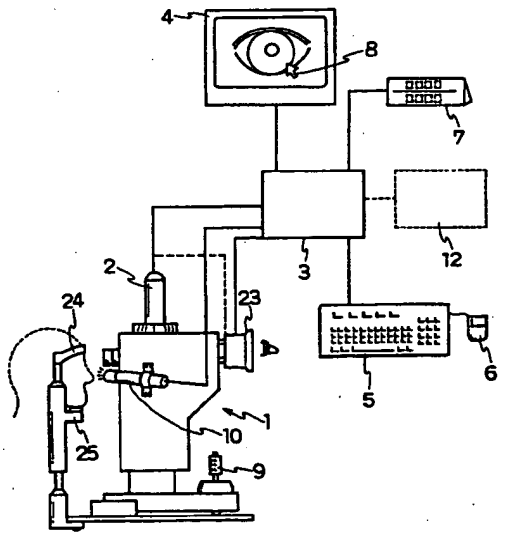
(54) MEASURING AND INSPECTING DEVICE FOR OPHTHALMOLOGY

(57) A device of the present invention includes: a means for photograghing an anterior eye segment of a subject; a first display means for displaying an image of the anterior eye segment; means for processing the displayed image to detect each position of a pupil and a contact lens; a calculating means for obtaining the relationship of relative positions between them by calculating; and a second display means for displaying the obtained relationship of the relative positions. If the device is used for inspcting a condition for putting on of the contact lens, in particular, it is possible to measure the relationship of the relative positions between the contact lens at the time of being put on and the pupil.

FIG. 1



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Description

TECHNICAL FIELD

The present invention relates to a measuring and inspecting device for ophthalmologic use which inspects a putting-on condition for a person putting on contact lens. More particurarly, it relates to a measuring and inspecting device for ophthalmologic use which inspects the relationship of relative positions between a contact lens being put on and a pupil.

BACKGROUND ART

Conventionally, the relationship of relative positions between a contact lens and a pupil has been decided by a inspecter's subjectivity with utilizing a slit lump biomicroscope. Therefore, it is difficult to measure the relationship of positions quantitatively, and there has not been any exclusive devices especially.

On the other hand, in contact lenses, there has also been one whose surface is not an unite sphererical surface but is aspherical surface such as an elliptic surface for the purpose of improving easiness for putting-on or optical effect of the contact lens. When such contact lens is put on, it is necessary to make a visual axis (a line of sight: a center position of a pupil) correspond with an optical axis of the contact lens so as to exhibit effect of the contact lens sufficiently. However, as mentioned above, the relationship of the positions between the pupil and the contact lens has been conventionally decided with relying upon the inspecter's subjectivity, thereby, there has been some cases wherein correct prescription, that is, prescription with correct grasp of the relationship of positions between the visual axis and optical axis can not be made.

Further, when a special lens such as a bifocal contact lens as shown in Fig. 4 (a contact lens having two kinds of refractive power), a multifocal contact lens (a contact lens having many kinds of refractive power), and a toric contact lens (a contact lens whose refractive power varies along the circumferencial direction at an interval of π) is put on, precise measurment can not be done although the visual axis and the optical axis of the contact lens have to be considered stirictly.

The present invention has been made to solve such problem in the conventional method for deciding the relationship of relative positions between the pupil (visual axis) and the contact lens, and it is therefore an object of the present invention to provide a device capable of measuring the relationship of the positions quantitatively and precisely to enable correct prescription of the contact lens easily based on the objective decision.

DISCLOSURE OF THE INVENTION

A measuring and inspecting device for ophthalmologic use of the present invention comprises: a photographing means for photograghing an anterior eye segment of a subject (a person to be inspected); a first display means for displaying an image of the anterior eye segment of the subject photographed by the photographing means; a first position-detecting means for processing the image of the anterior eye segment to detect a position of a pupil; a second position-detecting means for detecting a position of a contact lens put on the subject (a person to be experimented); a calculating means for calculating relationship of relative positions between the pupil and the contact lens based on positions of the pupil and the contact lens detected by the first position-detecting means and the second position-detecting means; and a second display means for displaying the relationship of the relative positions calculated by the calculating means.

Furthermore, it is preferable that the device further includes an illuminating means for illuminating the anterior eye segment of the subject from a viewpoint of making outer condition for measuring constant.

Further, it is preferable that the illuminating means is variable in illuminance from a viewpoint of enabling measurment in which various conditions (each lightness of inside of a room, outside, at night or the like) are assumed.

Further, it is preferable that an illuminance measuring means is provided, since lightness can be grasped quantitatively, and more precise measurment of a diameter of the pupil can be made.

Moreover, it is preferable that the first display means and the second display means are provided in the same display device, since an inspecter can recognize a condition of the image of the anterior eye segment and the relationship of the position thereof with corresponding them to each other, and space reduction of the device can be performed.

Further, it is preferable that the second display means is provided with a printer means since measured information can be made in the form of a paper.

According to the present invention, the image of the anterior eye segment of a subject which has been photographed by the photographing means is displayed by the first display means, and the image of the anterior eye segment is processed with the first position-detecting means, so that the position of the pupil is detected. Further, by utilizing the second position detecting means, the position of the contact lens put on by the subject is detected. Next, the relationship of relative positions between the pupil and the contact lens detected by the first detecting means and second detecting means is calculated by the calculating means, and this relationship of relative positions is displayed by the second display means, whereby the relationship of relative positions can be grasped quantitatively. Moreover, a rotational angle and a displacement or the like of the contact lens can be calculated quantitatively, which enables easy confirmation of the putting-on condition of the contact lens or decision of the prescription.

Further, by combination with the illuminating means, measurment under a constant condtion or various illum-

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nation conditions is also made possible. Still further, for a contact lens which requires an analysis on a complicated use condition, for example, a contact lens like a bifocal contact lens in which the pupil is covered by a plurality of optical power regions, effective measurment can be made.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a schematic explantory view showing an embodiment of a measuring and inspecting device for ophthalmologic use of the present invention;

Fig. 2 is a schematic explanatory view showing another embodiment of a display means portion of the measuring and inspecting device for ophthalmologic use of the present invention;

Fig. 3 is a schematic explanatory view showing another embodiment of an observing device portion of the measuring and inspecting device for ophthalmologic use of the present invention;

Fig. 4 is an explanatory view showing an embodiment of a contact lens in which effects of the measuring and inspecting device for ophthalmologic use of the present invention appears remarkably;

Fig. 5 is an explanatory view showing another embodiment of a contact lens in which effects of the measuring and inspecting device for ophthalmologic use of the present invention appears remarkably;

Fig. 6 is a schematic explanatory view showing an embodiment of a cursor (pointer) in the measuring and inspecting device for ophthalmologic use of the present invention; and

Fig. 7 is a schematic explanatory view showing an illuminance measuring means in a further another embodiment of the measuring and inspecting device for ophthalmologic use of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Next, an embodiment of a measuring and inspecting device for ophthamologic use of the present invention will be explained in detail refering to drawings. Fig. 1 is a schematic explanatory view of a measuring and inspecting device for ophthalmologic use of the present invention. In Fig. 1, numeral 1 denotes an observing device for observing an anterior eye segment. This device, to be more concrete, has almost the same basic function as that of a conventional slit lump biomicroscope, that is, the device is so constituted that an inspecter can observe an anterior eye segment of a subject whose chin is mounted on a chin rest 25 and whose forehead is applied to a forehead rest 24. In the present embodiment, the anterior eye segment of the subject is displayed on a television monitor 23 to allow the inspecter to observe the anterior eye segment. That is, as shown in Fig. 3(a), an image of photographed anterior eye segment is provided on a side which the inspecter observes by the television monitor 23 or the like, so that the inspecter is not required to approach his face to eyepieces compared with the slit lump biomicroscope, thereby operativity is improved. Furtheremore, as shown in Fig. 3(b), a mark 26 is disposed at the center portion of the television monitor 23. This is a target for making a visual axis of a subject correspond with an optical axis an optical system for photographing. An image of the anterior eye segment is moved by an operation bar 9 to position a center of a pupil at a position of the mark 26, thereby, the anterior eye segment can be effctively prevented from being photographed obliquely. In the present embodiment, the above-mentioned observing device 1 in which the inspecter does not need to look in the eyepieces directly is employed, but an observing device of a type in which the inspecter look in, can, of course, be also employed. Numeral 2 denotes a photographing means provided on the observing device 1. For this, a CCD camera is used in the present embodiment, however, any photographing means can be employed as far as it can provide a photographed image for the television monitor. Numeral 3 is a caluculating (processing) means for signal-processing an image photographed by the photographing means 2. Numeral 4 denotes a first display means, and as shown in figures, a television monitor for displaying the anterior eye segment of a subject or the like can be used. Numeral 5 denotes an operating board (key board), and numeral 6 denotes a mouse. By these elements, to be concrete, the device is so designed to enable the following operation. (1) A point to be measureed in the image of the anterior eye segment displayed on the displaying screen shown in Fig. 2, is pointed by the movement of the cursor 8. (2) Instruction of making the image of the anterior eye segment displayed on the above two monitors (that is, the first displaying means 4 and/or television monitor 23) a standstill picture or a moving picture is made. (3) Instruction of regurating illuminance of the light for illuminating the anterior eye segment is made. (4) Instruction of enlarging or contracting the image of the anterior eye segment displayed on the above two monitors is made.

In the present embodiment, as the first position detecting means and/or second position detecting means, there is employed means for processing a point to be measured as a coordinate information, the point being pointed on the screen through the operating board 5 or mouse 6. For example, various means such as means for position-detecting by recognizing figures in the device automatically after reading the image and means for directly pointing a point on the screen on which the image is displayed by means of a pen or the like, are employable.

Thus, the calculating means for calculating and processing the desired position detected by the first position detecting means and second position detecting means is, in this embodiment, installed in the aforsaid calculating (processing) means 3. For example, with respect to each position of a pupil center (x_1, y_1) detected by the first position-detecting means and a contact lens center (x_2, y_2) detected by the second position-detecting

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means, the relationship of relative positions therebetween is obtained by the following calculation:

$$(x_3, y_3) = (x_2-x_1, y_2-y_1)$$

Numeral 7 denotes a second display means, which is a digital display device for displaying the relationship of relative positions between the contact lens and pupil calculated by the calculating means. Furthermore, if the first display means 4 and the second display means 7 is provided on the same television monitor as shown in Fig 2, the inspector can preferably make a condition of the image of the anterior eye segment correspond with the position of the image. On the display means of Fig. 2, in addition to a diameter of the pupil and the relationship of the relative positions 15 between the pupil center 13 and center of the contact lens 14, other desired data (a name of a subject, recognition of left and right eyes, an area of the pupil, a displacement of the contact lens and so on) can be displayed.

Furthermore, in the embodiment, as the second display means 7, the digital display means or television monitor is shown as an example. A printer means such as a printer device capable of monochrome or color printing might be, however, attatched to the second display means 7. Similarly, a printer means might be attatched to the display means shown in Fig. 2 so as to enable printing of the image displayed on the display means. In these cases, information such as relationship of relative positions obtained by measuremnt can be outputted in the form of a paper.

Each example of a method for using the measuring and inspecting device and a procedure for operating it will now be described below.

(1) A subject who is putting on a contact lens is positioned at a predetermined position of the observing device.

(2) An inspector positions the observing device 1 with the use of the operation bar 9 so as to make an eye to be inspected come to a correct position, that is, come to a position where photographing can be done. The observing device might accomodate therein, a fixation light for maintaining a sight of the subject, thereby, the positioning can be done easily, and measurment and inspection succeeding to the positioning can be done more accurately.

(3) When photographing has become possible, for the purpose of entering a step for detecting relationship of relative positions between the pupil of the subject and the contact lens, at first, the operation board is used to pose the image of the anterior eye segment displayed on the first display means.

(4)The mouse 6 additionally disposed at the operation board 5 is used to detect the position of the pupil of the image of the anterior eye segment displayed on the first display means and the position of the contact lens.

To be concrete, at first, the operation board 5 is used to transmit a command of starting a work of detecting the position of the pupil to the calculating (processing) device 3, and to start a calculating (processing) program of the first position-detecting means for detecting the position of the pupil, thereby the position of the pupil is detected. Furthermore, in the present embodiment, the pupil is assumed to be an approximate circle, and arbitary three points of the outer periphery portion of the pupil is clicked by the mouse to detect the center position thereof.

Next, with respect to the position of the contact lens, the operation board 5 is similarly used to transmit a command of starting a work of detecting of the position of the contact lens to the calculating (processing) device 3, and to start a calculating (processing) program of the second position-detecting means for detecting the position of the contact lens, thereby the position of the contact lens is detected. Furthermore, with respect to the position of the contact lens, it is considered that the three points of the outer periphery portion are clicked to detect the center of the contact lens. However, a contact lens 21 having a mark 22 which is previously formed at the center portion thereof as shown in Fig. 5 might be used. This contact lens 21 with the mark 22 is one which is used for a trial (for a test), and at least a shape of the posterior surface is so formed as to be equall to that of a contact lens which is being put on actually (or will be put on). By the use of such contact lens for a trial, calculation of the relative position to the pupil can be perfomed much easiler. Especially, in the case of a soft contact lens, the outer shape thereof is generally large (about 11 to 14 mm) so that the soft contact lens is partially covered with an eyelid, thereby clicking of a point on the outer periphery portion becomes difficult. Therefore, it is very effective to form a mark at the center portion. Furthermore, when forming a mark like the contact lens of Fig. 5, there is no problem in making the center position of the mark correspond with a center of an outer shape (geometric center) of a contact lens as shown in Fig. 5. However, if an optical center of a contact lens is designed not to correspond with its geometric center, it is more preferable that the mark is correspondingly formed at the optical center. Moreover, there is no particular limitation with respect to design of the mark, however, such a technique as disclosed in Japanese Unexamined Utility Model publication No. 96532/1988 (that is, a technique for disposing a character and/or a symbol (for example, a *hiragana*, number, arrow mark or the like) at the center portion of the contact lens) can be effectively used.

(5)The detected position of the pupil and the position of the contact lens are calculated and processed by the calculating means to calculate the relationship of relative positions.

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(6)The relationship of relative positions obtained by calculation is displayed on the second display means.

Further, in the present embodiment, an illuminating means 10 is attatched to a side surface of the overving means 1, thereby, it is possible to illuminate the anterior segment to quantitively grasp a magnitude of a pupil diameter at illuminance at the time of measuring. Such illuminating means 10 might be accommodated in the observing device 10. Further, when the illuminating means can adjust illuminance, pupil diameters of a subject at different illuminances can be grasped. Moreover, in the present embodiment, the same mouse is used for both the first and second position-detcting means to decide each position on the first display means (to click with the mouse). The present invention is not, however, limited to this, and the positions might be decided respectively by different means. For example, in the first position-detecting means, the keyboard of the operation board might be operated to decide the position of the pupil, while in the second position-detecting means, the mouse might be used to decide the position of the contact lens.

Further, as shown in Fig. 7, if there is imployed a device wherein a half mirror is disposed on a light path of illumination, illuminance of an illuminating light is measured by an illuminance measuring means 28, and the measured value is simultaneously displayed on the first display means 4, television monitor 23 or the like through the caluculating (processing) means 3, it is possible to grasp illuminance quantitatively and to grasp a pupil diameter more accurately. Especially, a very effective measured value can be obtained when selecting a bifocal contact lens 16 as shown in Fig. 4. The bifocal contact lens 16 has an optical zone for a near vision correction region 19 at the center portion thereof and an optical zone for a far vision correction region 20 at the priphery portion thereof. It is judged where each of the vision area is positioned in the pupil 17 and how degree the area occupies at different illuminance, thereby, it becomes possible to provide a subject with more suitable contact lens. Furthermore, the overlapped area of a vision area and a pupil can be easily obtained by obtaining the diameter of the pupil simultaneously when obtaining the position of the pupil as described above, by obtaining similarly the shape of the one optical zone of the contact lens, and thereafter by calculating and processing. Further, it is of course possible to make the calculating (processing) device 3 memorise a calculating and processing function like this in advance. Furthermore, the method of obtaining the area is not necessarily limited to a case where an optical zone is circuler as shown in Fig. 4. It is possible to apply the method to optical zones with various shapes by utilizing the first position-detecting means and the second position-detecting means and to add a desired calculating and processing command (program) to a calculating (processing) device.

Operation of changing illuminance might be designed to be carried out by the operation board 5 shown in Fig. 1 or it might be designed to be carried by a dial-like regulating means 11 attached to the photographing means as shown in Fig. 3.

Moreover, in the case of a device having an illuminance measuring means 28 for measuring illuminance (referred to Fig. 7), by feeding back the measured result to the calculating (processing) device 3, the illuminance might be kept changing automatically until it reaches the illuminance set by the operation board. As the illumination measuring means 28, for example, a light meter on the market which is equipped with a light-receiving sensor, an operation amplifier and the like can be employed.

In the embodimnt shown in Fig. 1, a different display means is respectevely used for the first display means and the second display means, however, it is preferable if they are unified into one display means as shown in Fig. 2 from a viewpoint of operability and space reduction.

Further, by providing the caluculating (processing) device 3 with a means 12 for writing into a storage medium such as a floppy disk and for reading from the storage medium, each kind of measured results can be preserved or also conveyed.

Moreover, it is possible to detect position of the pupil and further to detect the relative positions between the contact lens and a cornea or the relative positions between the pupil and the cornea, with utilizing the position detecting means according to the present invention.

Further, according to the measuring and inspecting device of the present invention, it is possible to quantitatively measure a displacement of the contact lens on the cornea. That is, in the image of the anterior eye segment displayed on the first display means, if the relationship of relative positions between the contact lens and the pupil or cornea in the case where the contact lens is moved farthest on the eye is calculated respectively before and after movement to be compared with each other, the displacement of the contact lens against the eye of a person who puts on the contact lens can be obtained quickly.

Further, if the measuring and inspecting device of the present invention is used, not only the position of the contact lens, but also the rotational angle of the contact lens to a specified direction on the cornea can be obtained. Especially, in the case of the toric contact lens, refractive power changes at an interval of π as stated above, so that quantitative measurement of a position of this rotation angle is very useful.

Morover, since it is assumed that the shape of the pupil is circle, in place of an arrow-shaped cursor (pointer) 8 as shown in Figs. 1 to 2, a circular cursor (pointer) 18 of which diameter is optionally changeable as shown in Fig. 6 can also be used. Furthermore, such circuler cursor (pointer) 18 is movable and changable optionally in accordance with instruction from the operation means.

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As described above, if the device of the present invention is used, and the operation is done according to the predetermined procedure, the relative positions between the pupil and the contact lens, the rotational angle, the displacement of the contact lens and the like can be measured quantitatively and recognized. Thus, whether or not the contact lens can offer a user with a desired optical effect can be easily judged.

Further, by combination with the illumination means capable of regulating illuminance, the design of the contact lens to which the condition for putting on must be confirmed depnding on the outside condition, such as a bifocal contact lens whose plural optical power regions cover the pupil can be done easily.

INDUSTRIAL APPLICABILITY

A measuring and inspecting device for ophtalmologic use of the present invention has the first and second position-detecting means which detect positions of the pupil and the contact lens respectively, thus, it is effectively used for precisely measuring the relationship of relative positions between the contact lens being put on and the pupil.

Claims

1. A measuring and inspecting device for ophthalmologic use comprising: a photographing means for photograghing an anterior eye segment of a subject; a first display means for displaying an image of the anterior eye segment of the subject photographed by the photographing means; a first position-detecting means for processing the image of the anterior eye segment to detect a position of a pupil; a second position-detcting means for detecting a position of a contact lens put on the subject; a calculating means for calculating relationship of relative positions between the pupil and the contact lens based on positions of the pupil and the contact lens detected by the first position-detecting means and the second position-detecting means; and a second display means for displaying the relationship of the relative positions calculated by the calculating means.

2. The device of Claim 1, wherein the device further including an illuminating means for illuminating the anterior eye segment of the subject.

3. The device of Claim 2, wherein the illuminating means is variable in illuminance.

4. The device of any one of Claims 2 to 3, wherein the illuminating means is provided with an illuminance-measuring means.

5. The device of any one of Claims 1 to 4, wherein the first display means and the second display means are provided in a same display device.

6. The device of any one of Claims 1 to 5, wherein the second display means has a printer means.

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FIG. 1

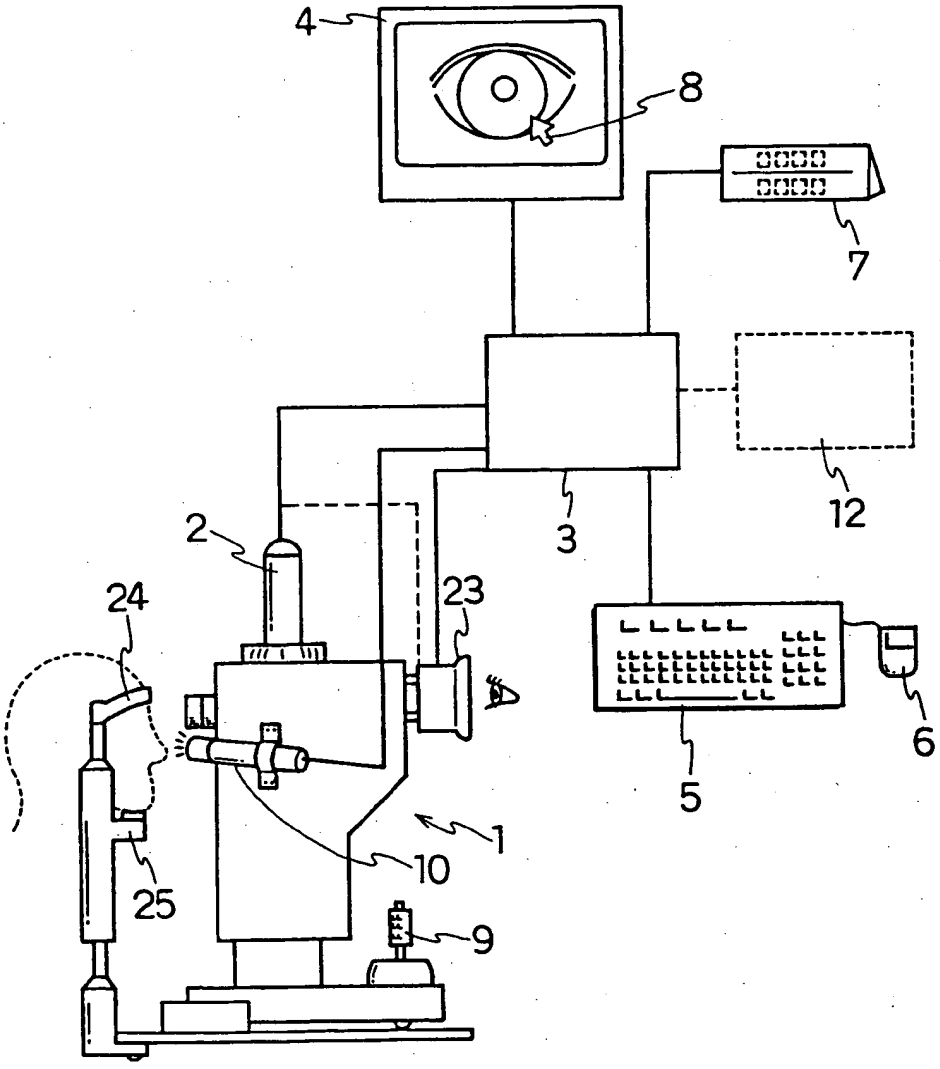

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FIG. 2

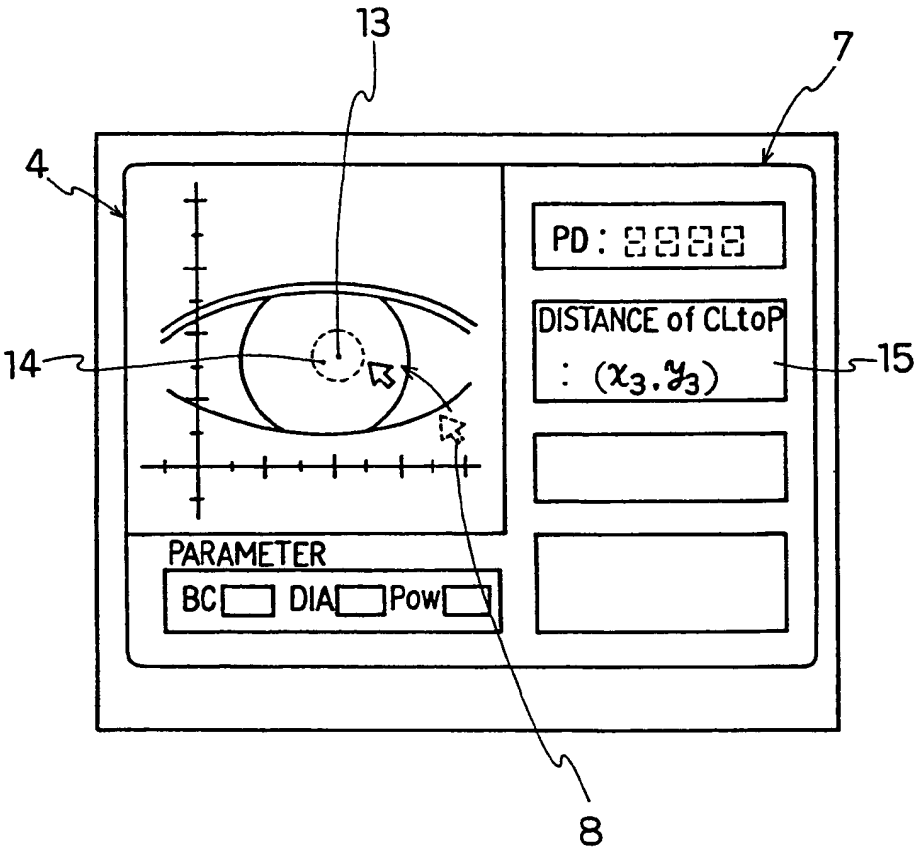

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FIG. 3(a)

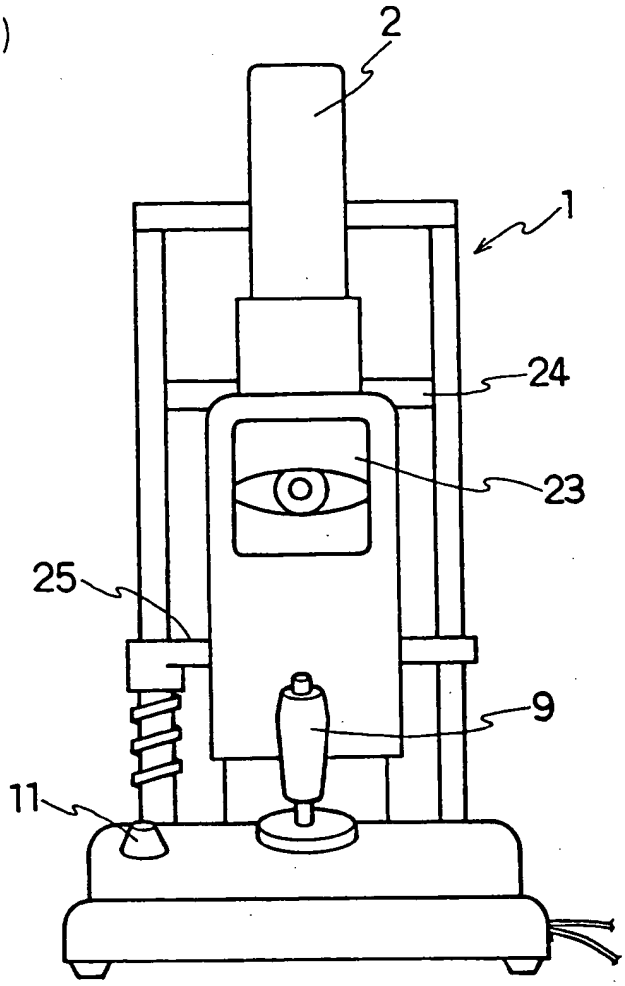

FIG. 3(b)

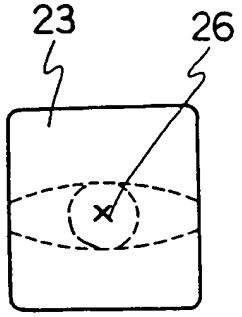

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FIG. 4

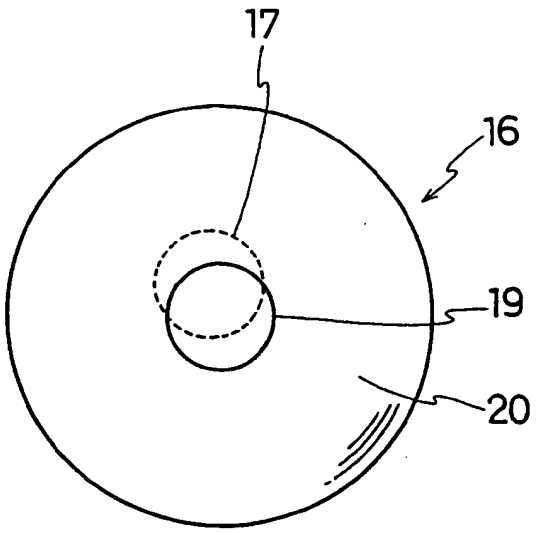

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FIG. 5

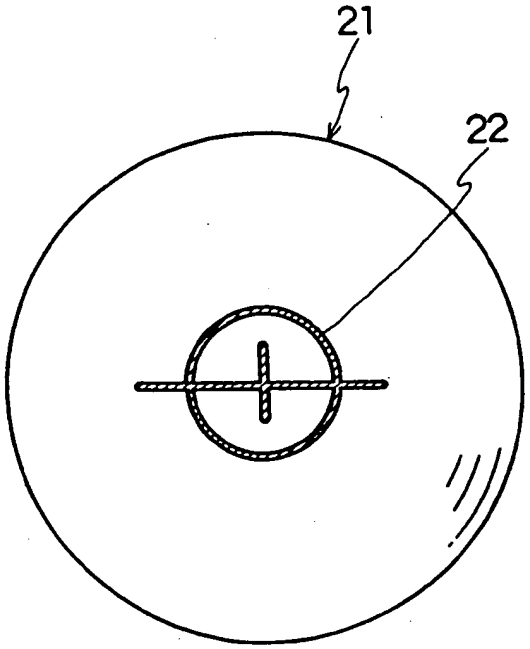

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FIG. 6

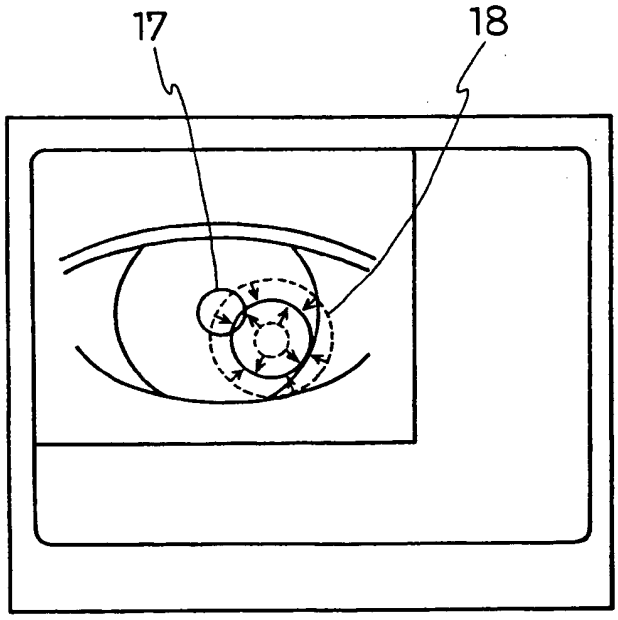

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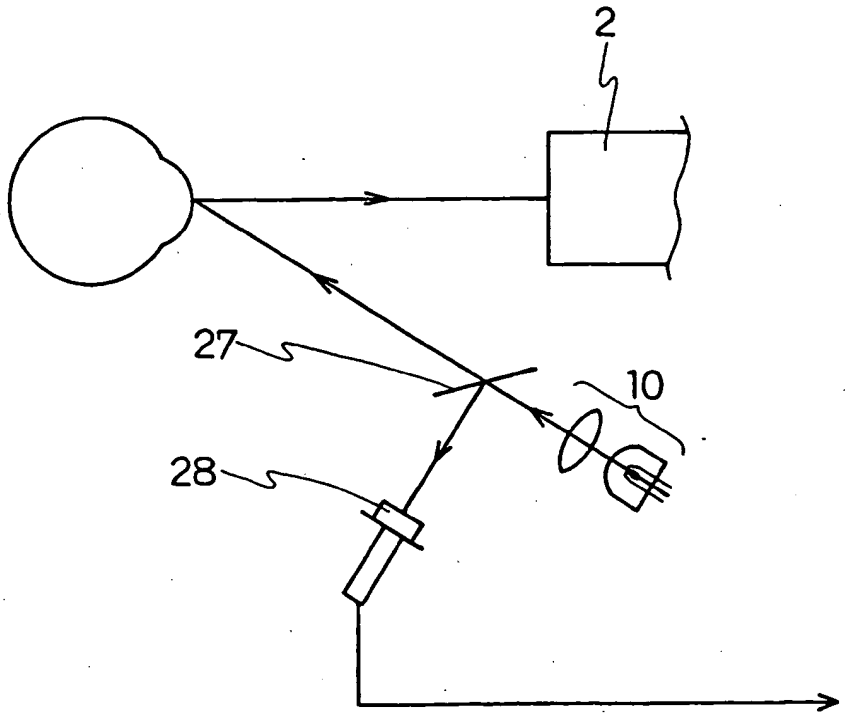
FIG. 7



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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP95/00258

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl^6 A61B3/13, A61B3/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl^6 A61B3/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1945 - 1994
Kokai Jitsuyo Shinan Koho 1945 - 1994

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, A, 4-200524 (Konan Camera Kenkyusho K.K.), July 21, 1992 (21. 07. 92) (Family: none)	1 - 6
Y	JP, A, 6-46998 (Nideck K.K.), February 22, 1994 (22. 02. 94), Lines 18 to 26, column 3, lines 33 to 36, column 4, Figs. 1, 2 (Family: none)	1 - 6
Y	JP, A, 54-158093 (Canon Inc.), December 13, 1979 (13. 12. 79), Claim 1 (Family: none)	2 - 6

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
April 14, 1995 (14. 04. 95)	May 2, 1995 (02. 05. 95)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

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